



# **Dnepr Program**

## **as a path to orbits**

## **for university spacecraft**

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**4<sup>th</sup> IAA Conference on University Satellite Missions**  
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## Space Centers of Universities

- ☐ In the 1990s, space centers for the development of micro- and nanosatellites were created and started their intensive activity in many universities worldwide;
- ☐ Striving to include space technologies into the students' academic process;
- ☐ Inexpensive orbit injection means turned out to be in demand;
- ☐ A new trend emerged in the rocket technologies: a piggyback launch or a cluster launch of a group of small satellites;
- ☐ Appropriate LV adaptation means and safe separation systems were created, collision-free separation methods were adopted, satellites' EMC compatibility tools were developed, etc.

# Involvement of students and young engineers at all stages of satellite creation and launch

## 1 stage

- Satellite designing
- Release of the full set of design and engineering documentation



## 2 stage

- Ground tests



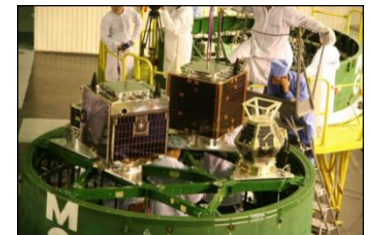
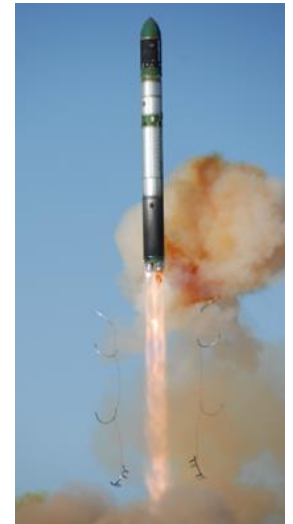
## 3 stage

- Manufacturing of satellite Flight Model
- Setup of the Ground Station



## 4 stage

- Cosmodrome activity – satellite pre-launch processing
- LAUNCH



## International Space Company KOSMOTRAS

- International Space Company KOSMOTRAS was founded in Russia in 1997;
- Dnepr launch vehicle is a converted SS-18 ICBM;
- From the outset of launch activities, ISC KOSMOTRAS committed to an active cooperation with universities and small startup companies on orbiting of micro-and nano-satellites, recognizing the particular importance of practical training of students and young engineers;
- In 1999 – 2015, 22 commercial Dnepr launches were performed, with 147 spacecraft from 31 countries, including 63 micro-and nano-satellites designed by Universities and 67 micro-and nano-satellites designed by small and startup companies.

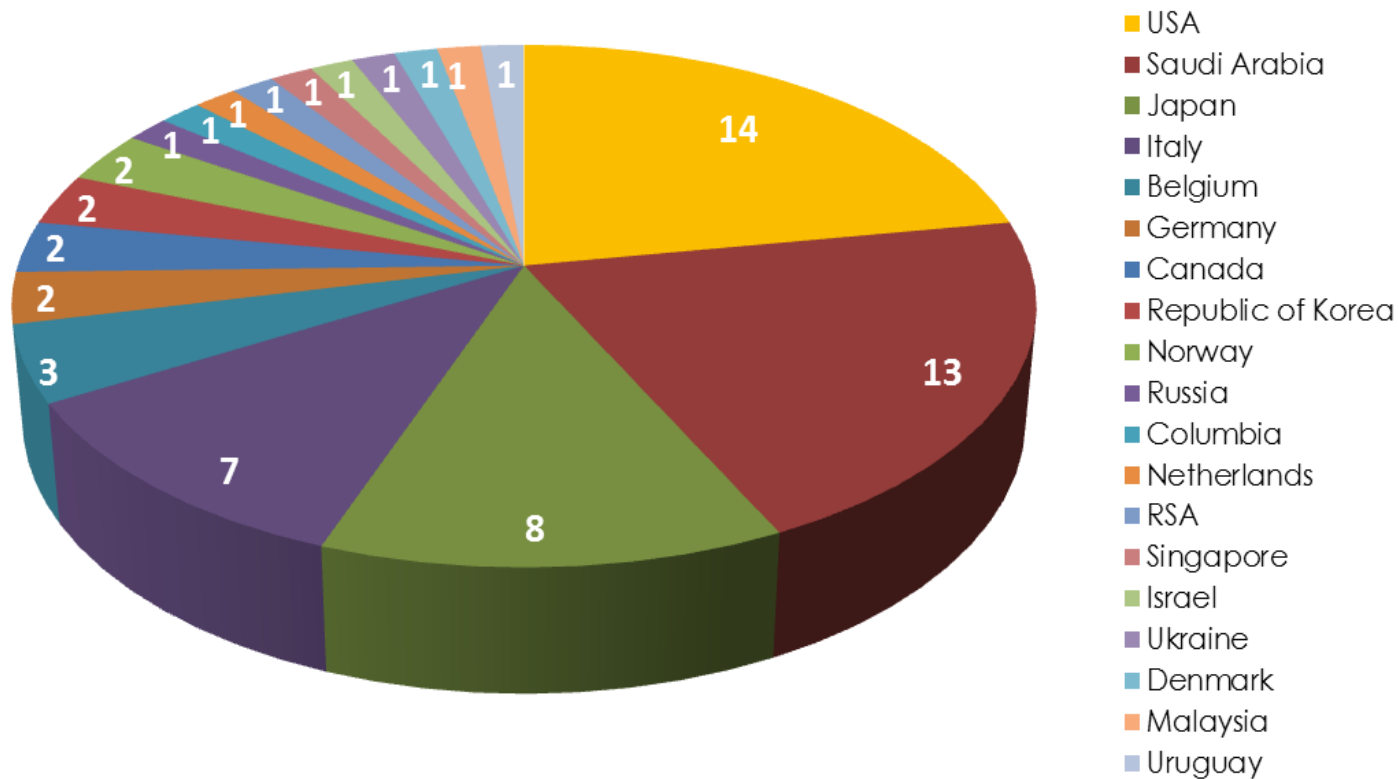




## University Satellites on Dnepr LV



Number of Satellites:

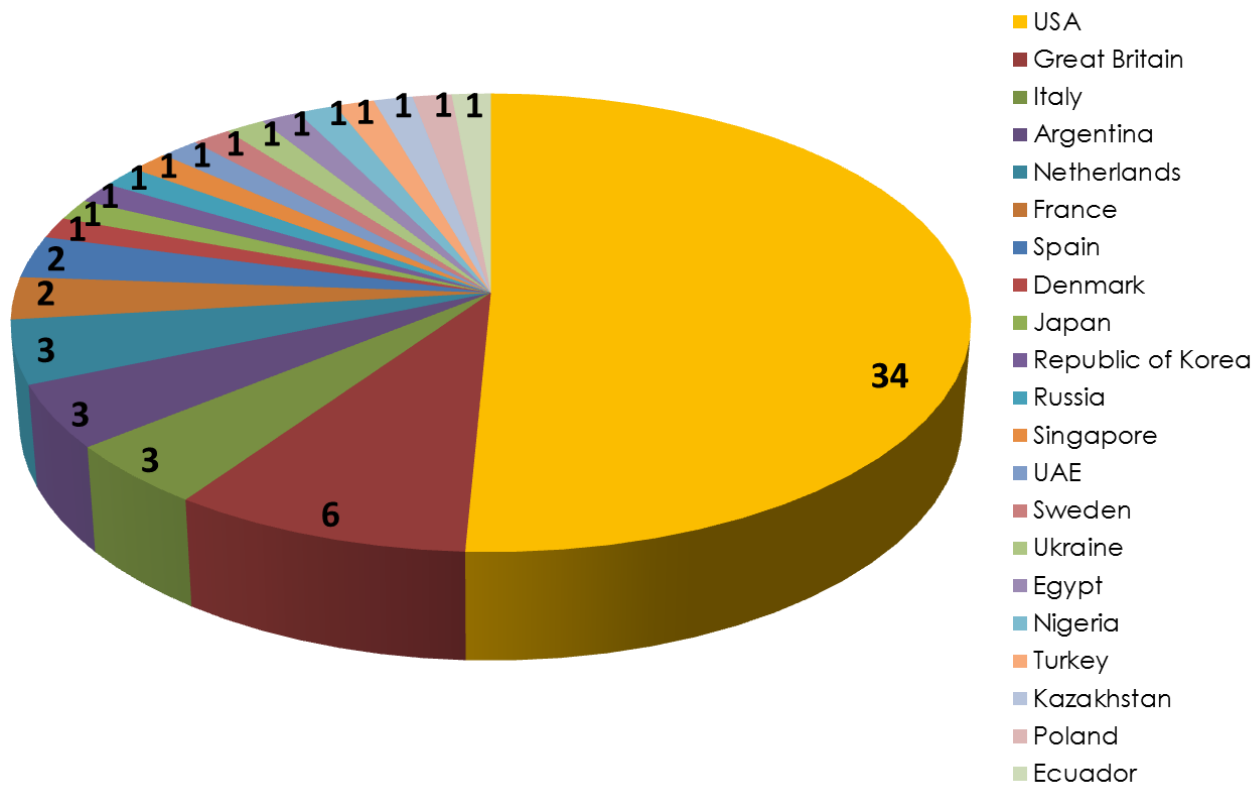


**63 spacecraft from Universities**

## Small and Start-up Companies' Satellites on Dnepr LV



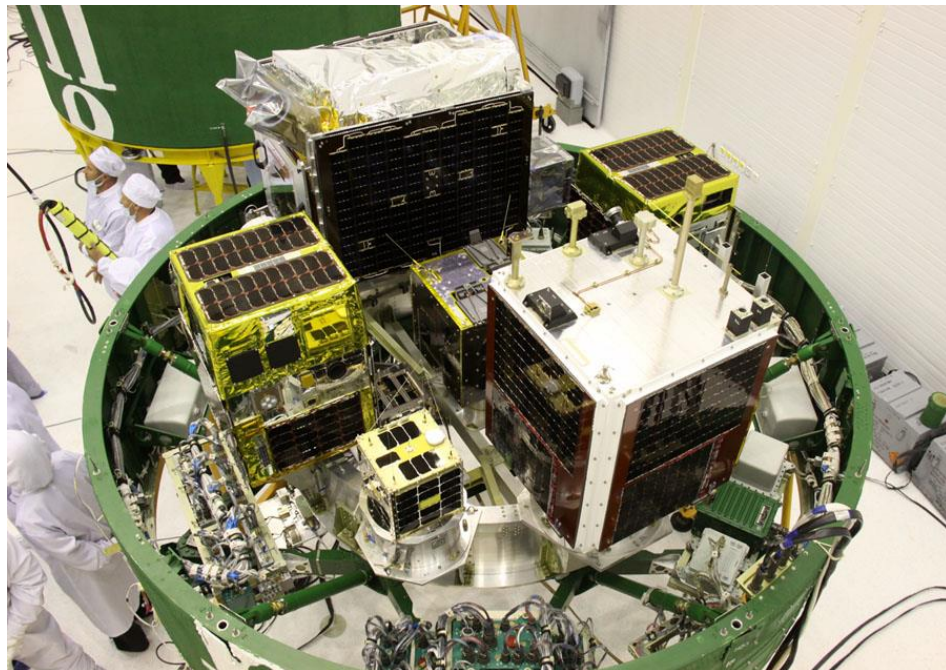
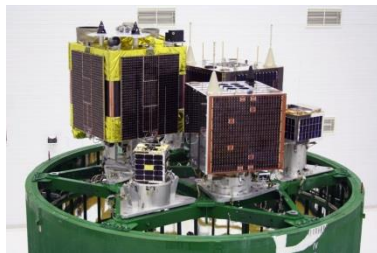
Number of Satellites :



**67 spacecraft from small and startup companies**

## Cluster Launches as the Foundation for International Cooperation

- A vast experience is gained in cluster launches – the most complicated missions from technical and procedural aspects



- The cluster launches have provided an access to space to a great number of micro- and nanosatellites





## Mission Profile for a Cluster Launch of Microsatellites



- The standard flight profile of SS-18 ICBM was optimal for a launch of microsat clusters;
- High accuracy in achieving target orbit;
- Low-shock satellite separation;





# Record 2014 Cluster Mission: 37 satellites from 18 countries

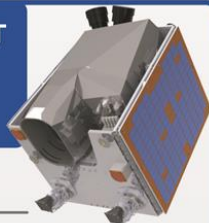


## KAZEOSAT

SURREY



Kazakhstan Gharysh Sapary  
Republic of Kazakhstan,  
SC mass: 177 kg



KazeOSat spacecraft will deliver wide swath, multi-spectral images with a GSD of 6.75 metres for agricultural and resource monitoring, disaster management, and land use mapping. Based on the SSTL-150 platform, the spacecraft is the medium-resolution element of a civil space observation system

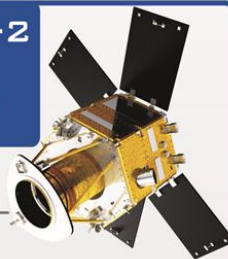


## DEIMOS-2

elecnor



ELECNOR-DEIMOS, Spain,  
SC mass: 300 kg



Deimos 2 is the first Spanish VHR Earth Observation satellite. It will deliver submetric panchromatic and multispectral (RGB+NIR) imagery for worldwide commercial purposes.



## TABLETSAT-AURORA



SPUTNIX, Russia, SC mass: 25 kg

TabletSat-AURORA is a commercial demo spacecraft designed to test a multipurpose platform in outer space environment as well as to conduct earth remote sensing for a private company. The satellite main purpose is to obtain necessary flight qualification and experience for further upgrade of the platform.

## UNISAT 6



Group of Astrodynamics  
for the Use of Space Systems  
Italy



SC mass: 26 kg

UNISAT-6 is a civil scientific satellite, mainly intended for Customer's equipment testing in space conditions. Also SC will release 4 CubeSats in orbit (Tigrisat, AeroCube6, Antelsat, Lemur-1) designed by different university in different country.



## BugSat-1 & 21 CubeSats



QuadPack  
Systems

QB50P1 & QB50P2 | NANOSATC-BR1 | PERSEUS-M1 & PERSEUS-M2

FLOCK1C-1 | FLOCK1C-11 | DTUSAT-2 | DUCHIFAT | POPSAT-HIP1 | PACE | POLYTAN-1



## BRITE-Toronto/BRITE-Montreal



SC mass: 7 kg

Pair of pair of nanosatellites belonging to BRITE-Constellation, will capture the light shed by luminous stars. BRITE-Constellation is the first network of satellites devoted to a fundamental problem in astrophysics.

## APRIZESAT 9 & 10



SC mass: 14 kg

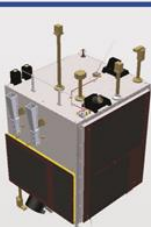
AprizeSat-9 and AprizeSat-10 are communication satellites designed for receiving and transmitting of short data packages from fixed and mobile assets, and to track the location of ships at sea

## SAUDISAT-4



KACST, Saudi Arabia, SC mass: 100 kg

SaudiSat-4 is a civil earth observation satellite designed for technology testing in outer space environment, gaining experience for future missions and engineers training

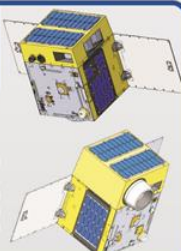


## HODOYOSHI-3,4

ほどうし 3,4 東京大学

University of Tokyo, Japan,  
SC mass: 58 kg & 64 kg

Hodoyoshi-3 and -4 are Earth observation satellites with GSD of 40m and 6m each. They carry Store and Forward data collection platforms. Hodoyoshi-4 is equipped with a Xenon Micro Ion Propulsion System and a 320Mbps 16QAM X-band data transmitter



# Small Satellites of “La Sapienza” University and GAUSS Srl, Italy

UNISAT (2000)



UNISAT-2 (2002)



UNISAT-3 (2004)



EDUSAT (2011)



UNISAT-5 (2013)



UNISAT-6 (2014)





# THANK YOU FOR YOUR ATTENTION!

